Synthetics Mimic Natural Brain Chemicals

Changing an insect's behavior by "messing with its brain" may be the way to stop pests in the future. Agricultural Research Service scientists have developed artificial brain chemicals designed to mimic natural chemical messengers that control molting and other life functions.

"Commercial products containing artificial neuropeptides that can be sprayed onto corn earworms, for example, could be developed in about 5 years," says Ronald J. Nachman. He is a chemist in the ARS Veterinary Entomology Research Unit at College Station, Texas.

Nachman and ARS entomologist G. Mark Holman began studying neuropeptides—chemical messengers sent out in insect brains to stimulate life-sustaining functions—in 1987. These messengers are made up of strings of amino acids, the building blocks of protein, and control an array of behaviors. They can halt molting (shedding of outer covering), upset mating, alter digestion, or disturb water balance.

By 1996, Nachman and Holman had built the first of eight analogs—artificial versions that mimic natural brain chemicals.

The artificial versions don't work quite like the real thing.

The biggest problem in delivering the mimics was getting them to penetrate the pest insects' tough skin, or cuticle. Nachman overcame this obstacle in the laboratory by using a combination of boron, carbon, and other chemicals, replacing one part of a string of amino acids with this combination. The result: The molecule became greasy. The greasy quality of the molecule matched the physical characteristic of the insects' cuticle, making absorption into the insect possible.

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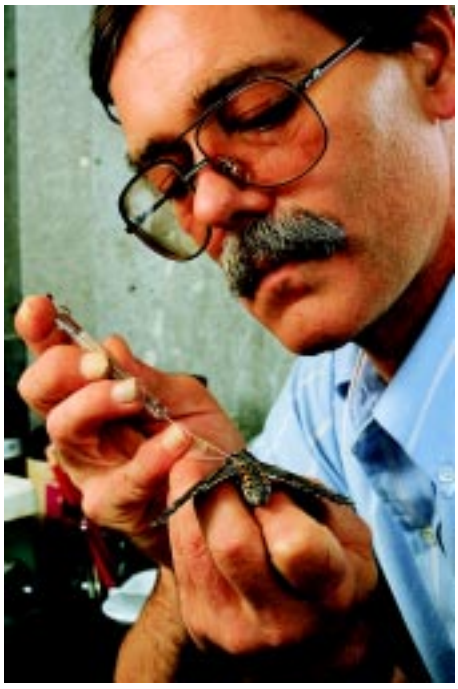

To control pheromone production and other life functions, insect physiologist Peter Teal applies artificial neuropeptide chemicals to a tobacco hornworm moth.

Neuropeptides stimulate life-sustaining functions in insects. An array of critical functions and behaviors, including digestion and mating, are controlled by these strings of amino acids.

Nachman sent his greasy analog to ARS insect physiologist Peter E. A. Teal in Gainesville, Florida, for further testing.

To stimulate the production of sex pheromones, Teal applied the analog to the skin of tobacco budworms and cotton bollworms. Both of these major cotton pests have adapted to commonly used chemical insecticides, making them less effective, notes Teal.

Normally, these insects produce pheromones—in this case, female sex odors released to attract males for mating—for 3 hours. Teal demonstrated that some of the analogs caused both species to produce pheromones nonstop for 20 hours.

"This strategy could cause the insect to run out of pheromone-producing chemicals and make it impossible for the insect to attract mates," says Teal.

This work represents a significant milestone in developing environmentally friendly pest insect management strategies. Nachman, Teal, and Holman are pursuing patents on all the compounds.—By **Linda Cooke McGraw,** ARS.

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